

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A system for predicting roller cone drill bit failure, comprising:

a drill string having a drill bit; ~~and~~

a plurality of sensors connected to collect strain data from said drill bit; and
circuitry for calculating relative changes in strain between said sensors;

wherein said strain data is used by said circuitry to calculate relative changes in strain between said sensors to thereby predict bit failure.

2. (original) The system of Claim 1, wherein said relative changes in strain between said sensors is used to determine bit condition.

3. (currently amended) A system for predicting drill bit failure, comprising:

a drill string having a down hole sub assembly, said sub assembly including a plurality of sensors which measure strain;

circuitry for calculating relative average strain among said sensors; and

a drill bit removably attached to said sub assembly;

wherein strain data from said sensors is used by said circuitry to calculate the relative average strain among said sensors.

4. (original) The system of Claim 3, wherein said relative average strain among said sensors is used to estimate the drill bit condition.

5. (currently amended) A system for detecting roller cone drill bit failure, comprising:

a plurality of sensors on the lower end of a drill string connected to collect data relating to a bending moment of said lower end; and
circuitry for calculating changes in average bending moment of said lower end;

wherein said data is used by said circuitry to calculate changes in average bending moment.

6. (original) The system of Claim 5, wherein said changes in average bending moment are used to ascertain drill bit condition.

7. (original) A system for detecting roller cone drill bit failure, comprising:
a plurality of sensors on the lower end of a drill string, each of said sensors connected to detect relative change in axial strain at a particular location;

wherein bit failure is indicated when said relative change in axial strain exceeds a predetermined test.

8. (currently amended) ~~The system of Claim 7, wherein said sensors are~~
A system for detecting roller cone drill bit failure, comprising:

a plurality of sensors on the lower end of a drill string positioned on a sub assembly located above said roller cone drill bit, each of said sensors connected to detect relative change in axial strain at a particular location;

wherein bit failure is indicated when said relative change in axial strain exceeds a predetermined test.

9. (currently amended) A system for detecting drill bit failure, comprising:
a plurality of sensors on the lower end of a drill string connected to collect
strain data from said lower end, said lower end having a drill bit with
one or more cones; and
circuitry for calculating average load supported by each of said cones;
wherein said strain data is used by said circuitry to calculate the average load
supported by each of said cones.

10. (original) The system of Claim 9, wherein said data is used to ascertain
bit condition during drilling.

11. (canceled)

a/ 12. (currently amended) ~~The method of Claim 11~~ A method for detecting
drill bit failure, comprising:
monitoring at least one bending strain in a bottom hole assembly, wherein
said bending strain is measured by sensors located on a sub assembly
located above the drill bit on the drill string; and
dynamically assessing degradation of said bottom hole assembly in
dependence on said bending strain.

13. (currently amended) A method for drilling, comprising:
monitoring at least one bending strain in a bottom hole assembly which
includes a drill bit, wherein said bending strain is measured by sensors
located on a sub assembly located above the drill bit on the drill
string; and
dynamically assessing and signalling degradation of said bottom hole
assembly in dependence on said bending strain.

14. (currently amended) The ~~system~~method of Claim 13, further
comprising the step of halting drilling in dependence on said step of
dynamically assessing.

a/ 15. (original) A method for drilling, comprising:
monitoring differential cone loading in a roller cone drill bit; and
dynamically assessing and signalling degradation of said drill bit in
dependence on changes in said differential cone loading.

16. (currently amended) The ~~system~~method of Claim 15, further comprising
the step of halting drilling in dependence on said step of dynamically
assessing.

✓ 17. (original) A method of predicting drill bit failure, comprising the
steps of:
taking multiple strain measurements from an instrumented sub assembly;
and
deriving information regarding bit wear from relations between said
respective measurements.

✓ 18. (currently amended) ~~The system of Claim 17A~~ method of predicting drill bit failure, comprising the steps of:
taking multiple strain measurements from an instrumented sub assembly,
wherein said instrumented sub assembly does not electrically
communicate with said drill bit; and
deriving information regarding bit wear from relations between said
respective measurements.

✓ 19. (original) A method of predicting drill bit failure, comprising the
steps of:
analyzing the relative strain induced on different parts of a bottom hole
assembly during drilling;
predicting drill bit failure based on said relative strain.

20. (original) The method of Claim 19, wherein said bottom hole assembly
comprises a drill bit and an instrumented sub assembly.

21. (original) A method of predicting drill bit failure, comprising the
steps of:
collecting strain data from a plurality of gauges connected to measure strain
induced on a drill bit during drilling;
computing a ratio of average strain at each said gauge relative to another
said gauge;
halting drilling when said ratio exceeds a test.